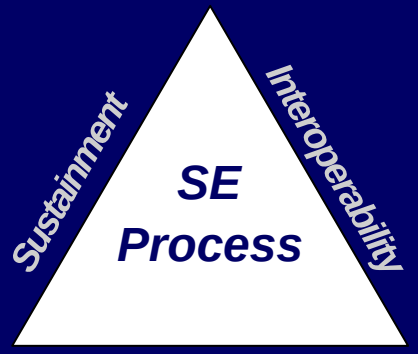
Certified
Naval Battle Groups



Applying Systems Engineering To Family-of-Systems Acquisition

NDIA Systems Engineering Conference
October 21-24 2002

J.M. Rebel
Director, Large Scale Systems Engineering

Outline

RDA CHIEF ENGINEER

- Problem Statement
- Background
- Navy Initiatives
- The Systems Engineering IPT
- Use of the Systems Performance Document
- Status and Future Plans

The Problem

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- Need to Achieve Warfighting Capability at Battleforce Level
- Requires Systems to Work Together to Achieve Capability
- Past Experience Shows We Don't Do This Well
- Vision of Future Network Centric Warfare Requires Us to Do a Better Job at Resolving Integration & Interoperability Issues

We Fight With System-of Systems
We Engineer and Procure Single Systems

Inadequate Integration & Interoperability Exacts a Price

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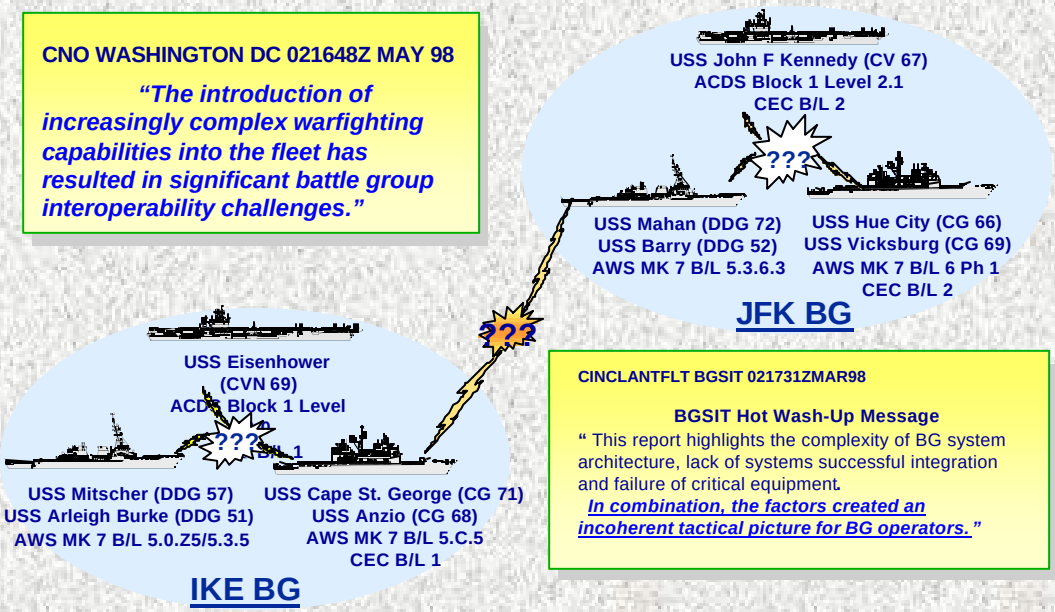
Navy Battle Group Operations: 1997 - 1998

CNO WASHINGTON DC 021648Z MAY 98

"The introduction of increasingly complex warfighting capabilities into the fleet has resulted in significant battle group interoperability challenges."



CINCLANTFLT BGSIT 021731ZMAR98

BGSIT Hot Wash-Up Message

" This report highlights the complexity of BG system architecture, lack of systems successful integration and failure of critical equipment. *In combination, the factors created an incoherent tactical picture for BG operators."*

Resolutions of System Deficiencies:

- *Caused Nearly 10% Program Growth*
- *Perturbated Program Execution Budget and Timelines*
- *Disrupted CINC Deployment Plans*

What's Needed? . . . *Elevating Systems Engineering to a New Level*

Background

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- Ike Battlegroup Issue -'97/'98
- Sea-53 Role Assigned By OPNAV – '98
- RDA CHENG Established By ASN RDA - Apr 1999
  - "Senior Technical Authority Within The Acquisition Structure For The Overall Architecture, Integration And Interoperability.."
- N-70 Established In OPNAV - Nov'01
  - "Modify PPBS Process to Focus on Capability-Driven Warfighting"
- New SECNAV 5000.2 Drafted - '01-'02
  - Adds Requirements for Systems Engineering of System-of-System and Family-of-System Acquisition

Navy I&I Initiatives

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- D-30 Process
  - Key player - SEA-53 for OPNAV
  - Key product- Battleforce Certification
- BCAPP
  - Key Player - OPNAV (N-70)
  - Key Product - Capability Evolution Description (CED)
- Architecture Based Systems Engineering Approach
  - Key Player - RDA CHENG
  - Key Product - SoS/FoS Architecture & Assessments
  - Supports D-30, BCAPP, and Acquisition Processes
  - Use of Systems Engineering IPT & System Performance Document (SPD)

Integration of Critical Decision Processes

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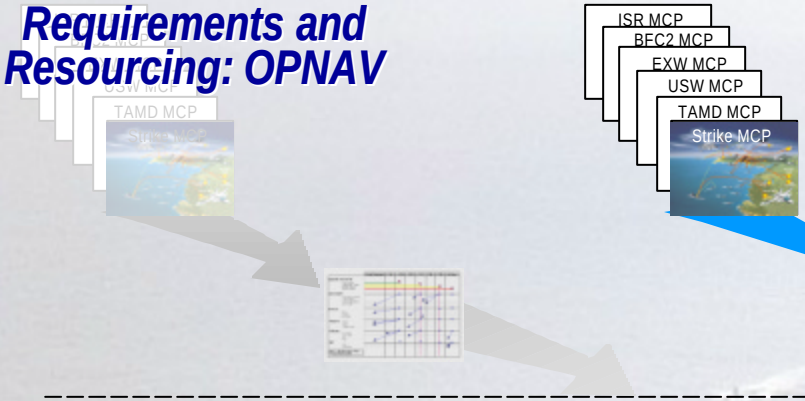
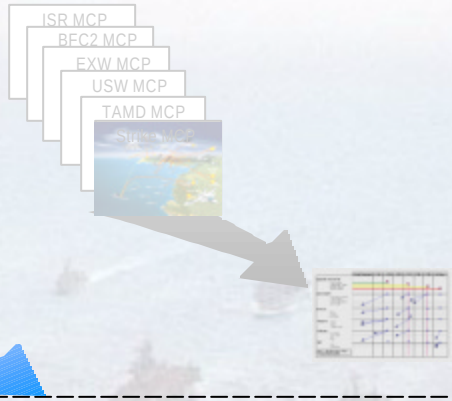
Requirements and Resourcing: OPNAV



CED



Acquisition: ASN (RDA), PEOs/PMs

Battle Group Deployment: Fleet /SEA 53

CED- Capability Evolution Description
MCP- Mission Capability Package
SPD- Systems Performance Document

Alignment is Needed Between Resourcing, Acquisition, and Deployment

The Architecture Based Systems Engineering Process

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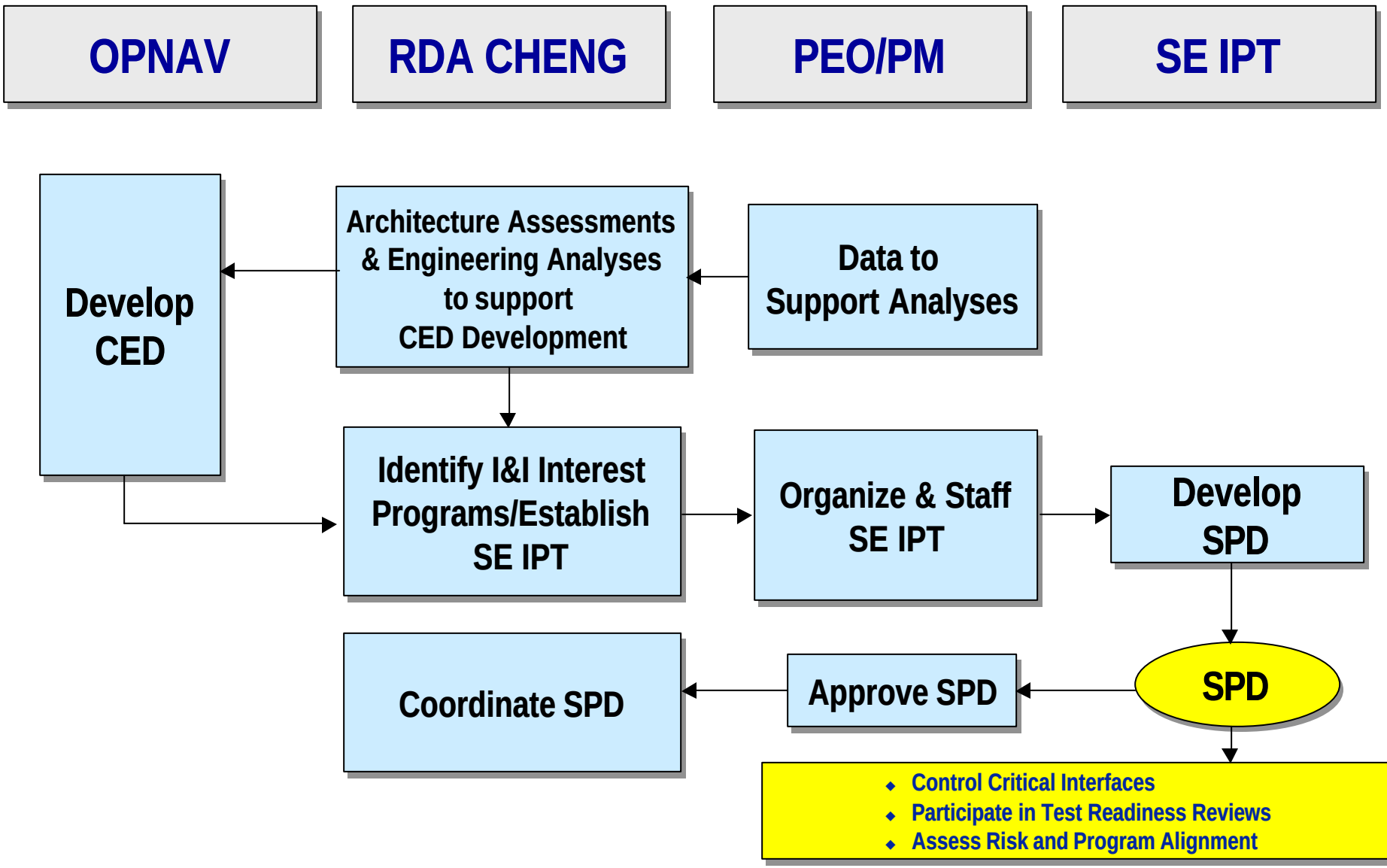

Using the Systems Engineering Process to Develop the Acquisition Plan

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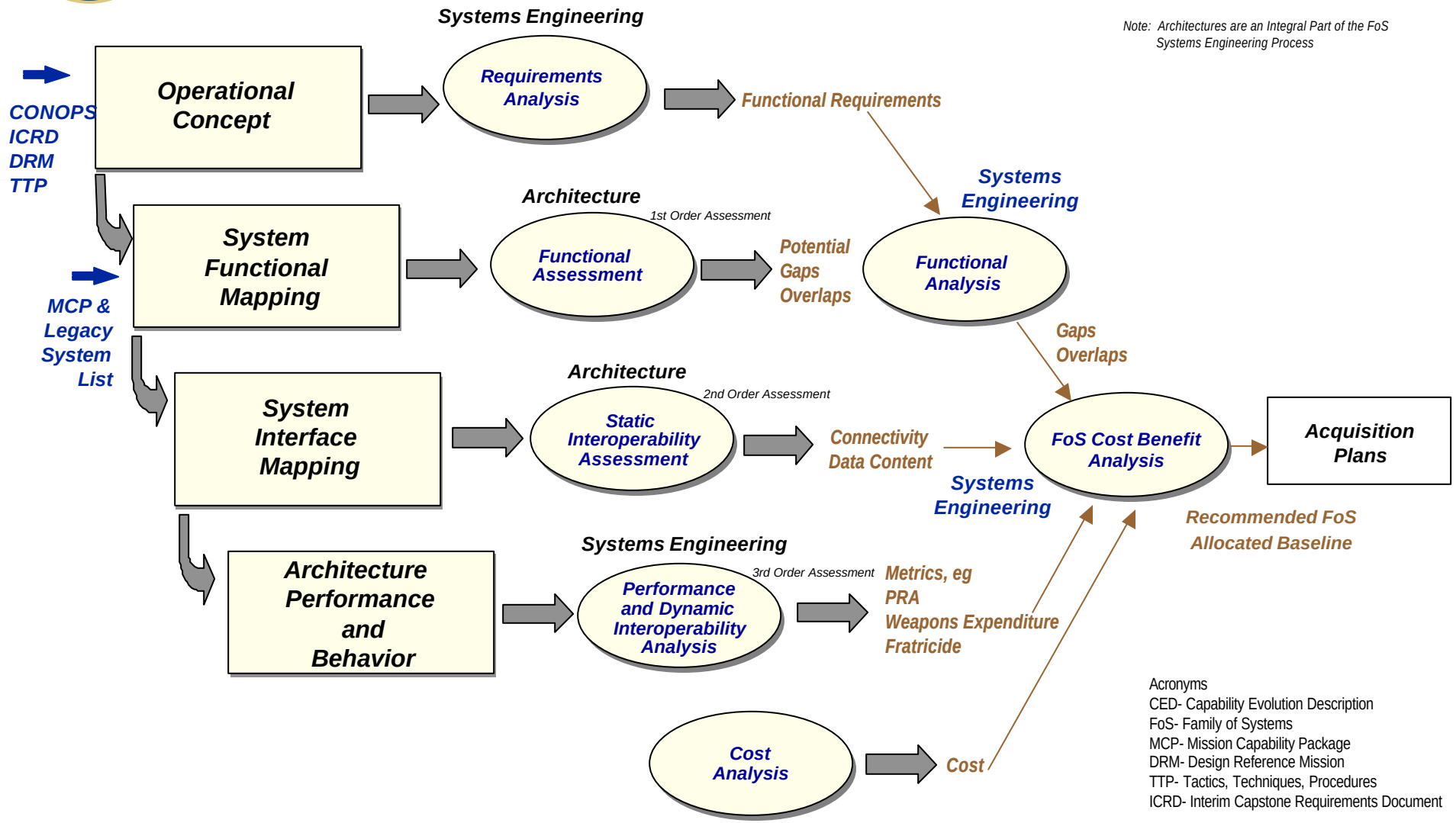

Acronyms
CED- Capability Evolution Description
FoS- Family of Systems
MCP- Mission Capability Package
DRM- Design Reference Mission
TTP- Tactics, Techniques, Procedures
ICRD- Interim Capstone Requirements Document

Acquisition Plans Derived Through Architecture Assessments and Systems Engineering Trades

Notional Strike CED Sample

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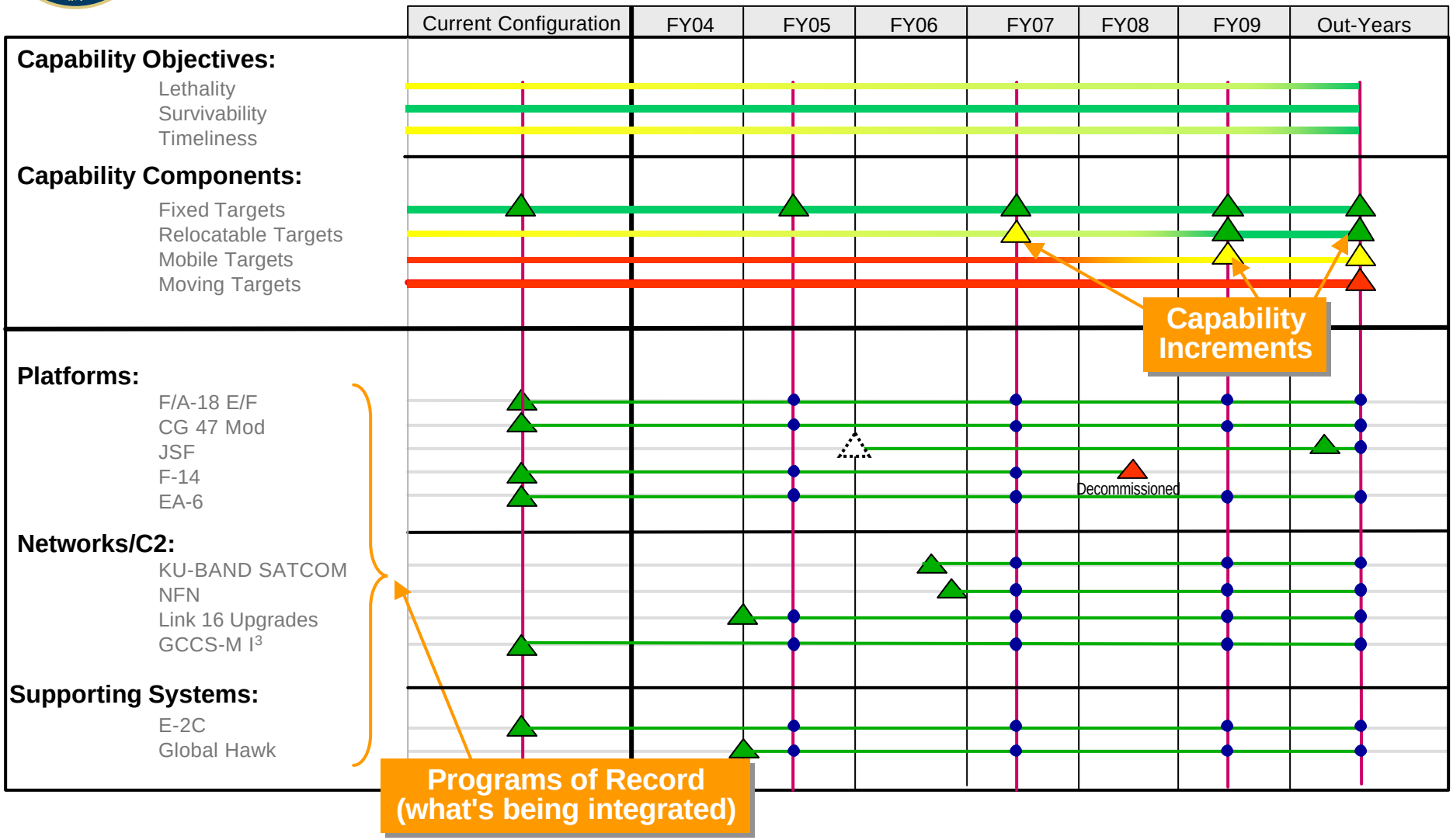

Flag Level CED Will Hide Sensors and Weapons Under Platforms

The Systems Engineering IPT

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- **Pre-Milestone B**
  - Develop Program Alternatives
  - Support Analysis of Alternatives
  - Develop Integrated Architectures
  - Conduct C4ISP Review
- **Post Milestone B**
  - Develop System Performance Document
    - Quantify and Allocate MCP Functions and Performance
    - Identify Critical System Interfaces
    - Establish Demonstration/Validation Plan
  - Approve and Control Critical System Interfaces
  - Participate in Test Readiness Reviews
  - Assess Risk and Program Alignment

Two SE IPT Examples

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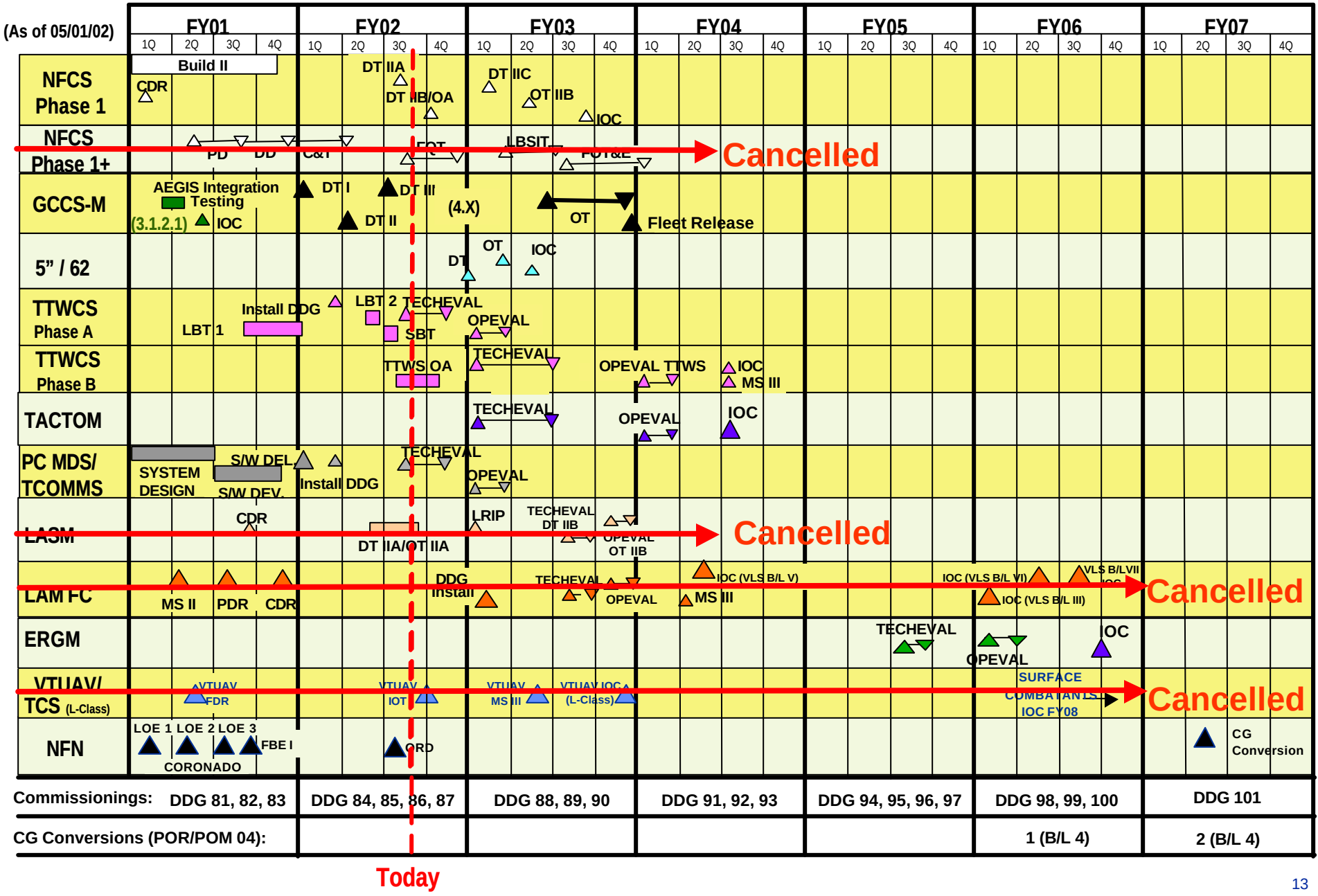
- Land Attack
  - Not Derived From Our Process
  - Generated an SPD
  - Some “Lessons Learned” Achieved
- NFN
  - Just Starting
  - Self Initiated

Land Attack Program Schedules



NFN Recommendation: "Develop a System Performance Document"

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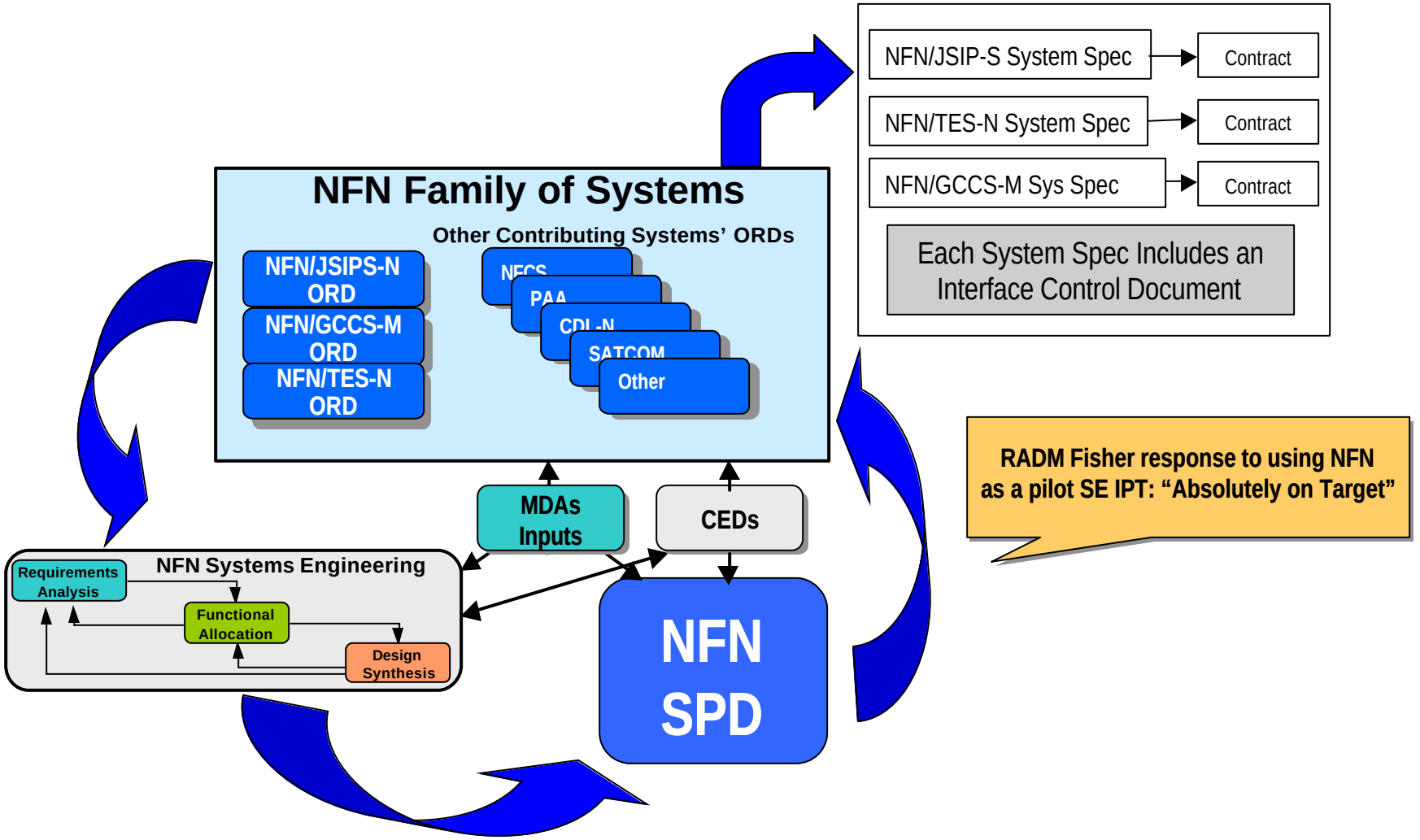

NFN Systems Engineering IPT is a Pilot for TST SPD

System Performance Document (SPD)

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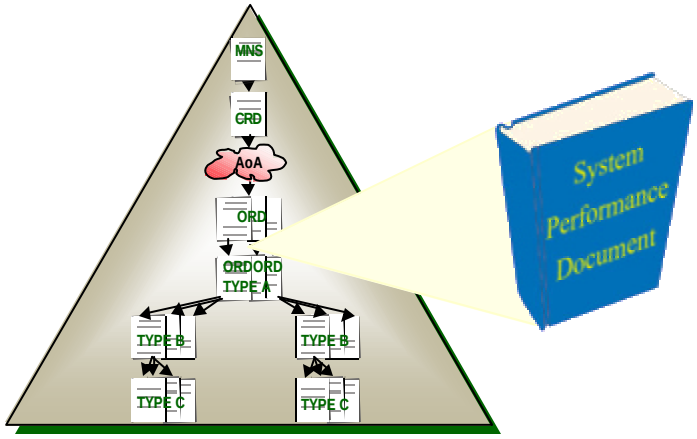
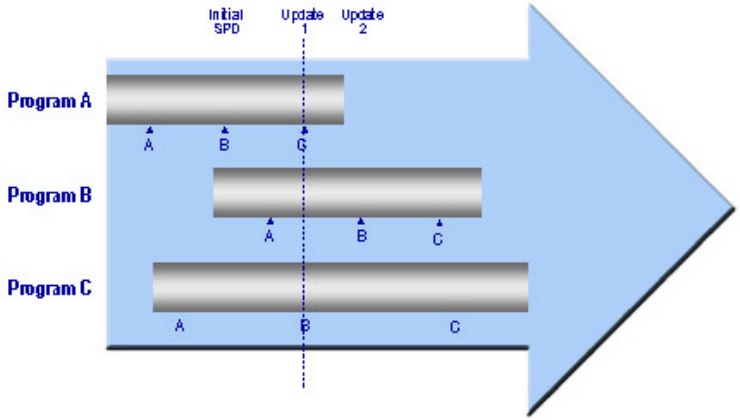
- Developed by System Engineering IPT with Program Office SMEs
- Translates architecture descriptions into a FoS/SoS specification
  - Functional and performance allocations for selected portfolios
  - Defines FoS performance metrics and test plans



Requirements Generation System has Addressed Integration and Interoperability for SoS/FoS



SPD as a Living Document

Defines Engineering Plan to Achieve Mission Capabilities

What is an SPD?

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- "A Means of Communicating Key Technical Requirements Early in the Life Cycle" (Defense Acquisition Desk Book)
- Not Universally Used Across DOD, No Standard Format
- When Used for Individual Systems - Assists the Contractor in Identifying Key Requirements, a First Step in Developing a System Specification
- When Used for Sos/FoS:
  - Allocates Functions and Performance Requirements to Systems
  - Assists in Early Identification of I&I Requirements
  - Specifies Essential Requirements for the System to Perform Its Assigned Task Within the Context of a Larger Mission

A Key Product of the BFSE Process

Suggested SPD Contents

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- Typical Mil Spec Outline - Scope, Applicable Documents, Requirements, Qualification Provisions, and Appendices
- Key Requirements to address: Required states and roles; System Capability; External Interfaces; Internal Data; Computer Resources; Human System Integration; Training; Logistics; and Other

Status and Future Plans

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- Continue With 2 SE IPT "Pilots"
- Generate Several New SE IPT As a Result of PR-05 BCAPP Process
- Document Policy (Either Sec Nav 5000.2C or RDA I&I Instruction)
- Continuous Improvement of Processes
- Expand to Include Joint and Coalition Systems

Questions?

Backup

Generic System Engineering Process

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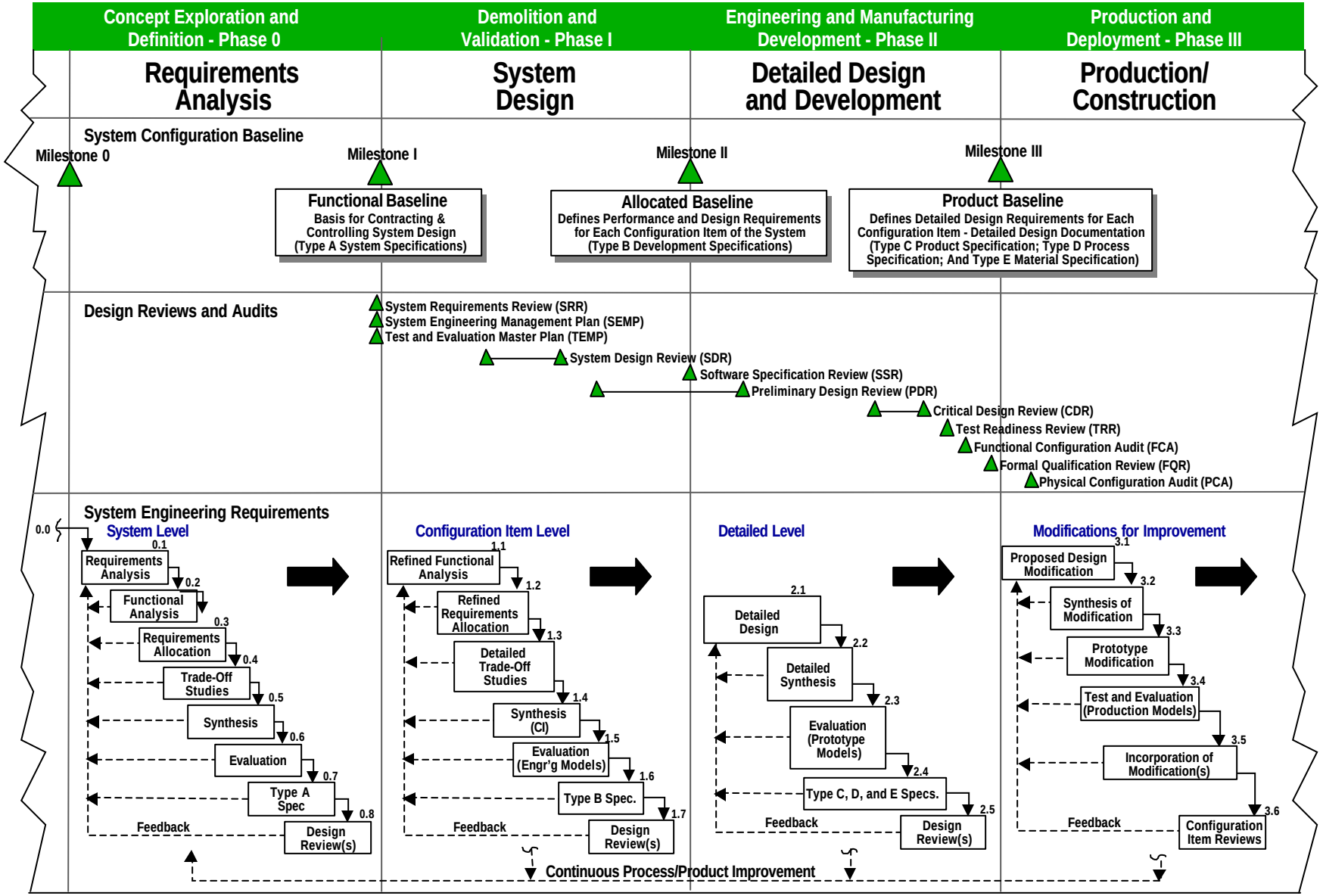
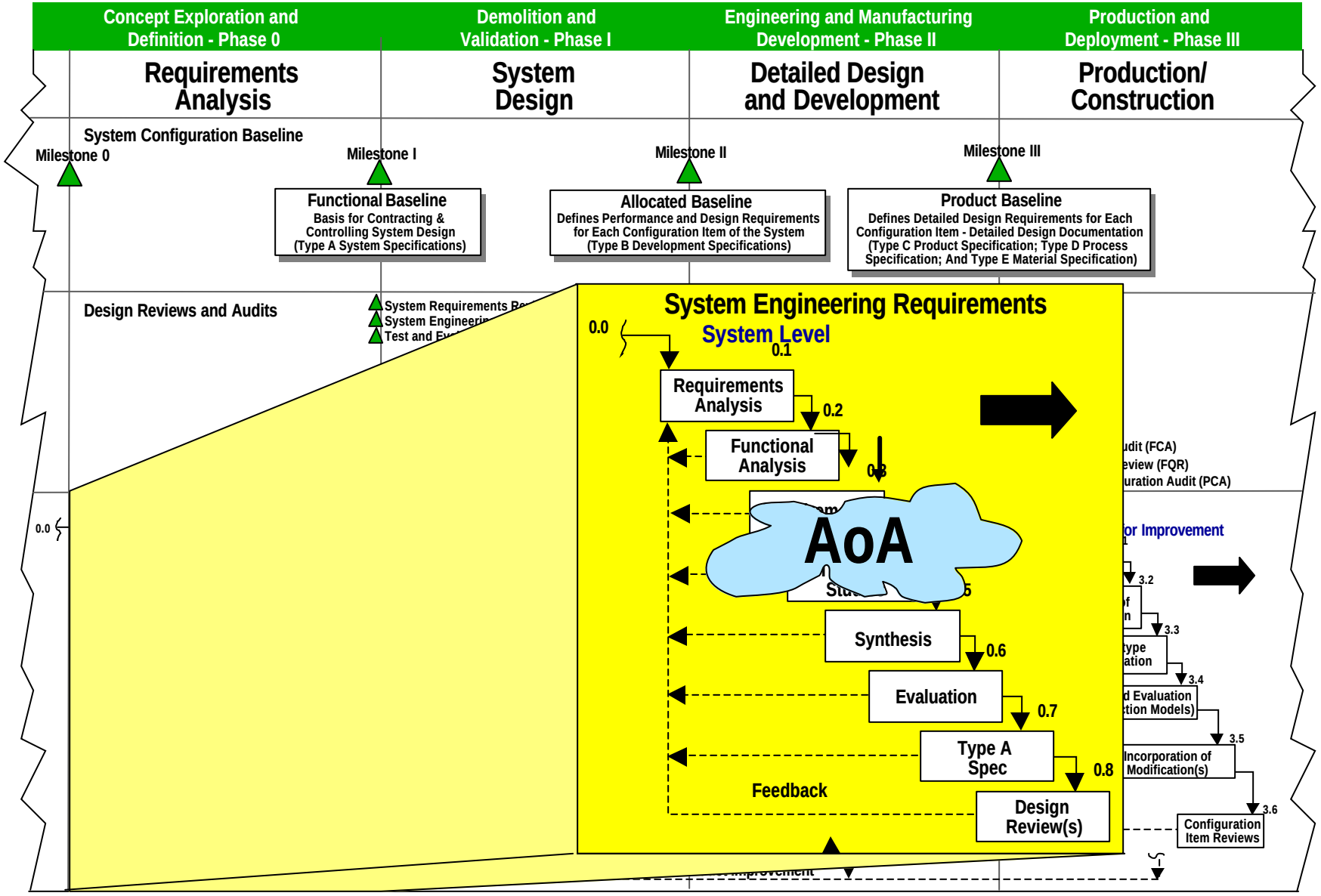


Generic System Engineering Process

RDA CHIEF ENGINEER



Notional SRD Development Approach

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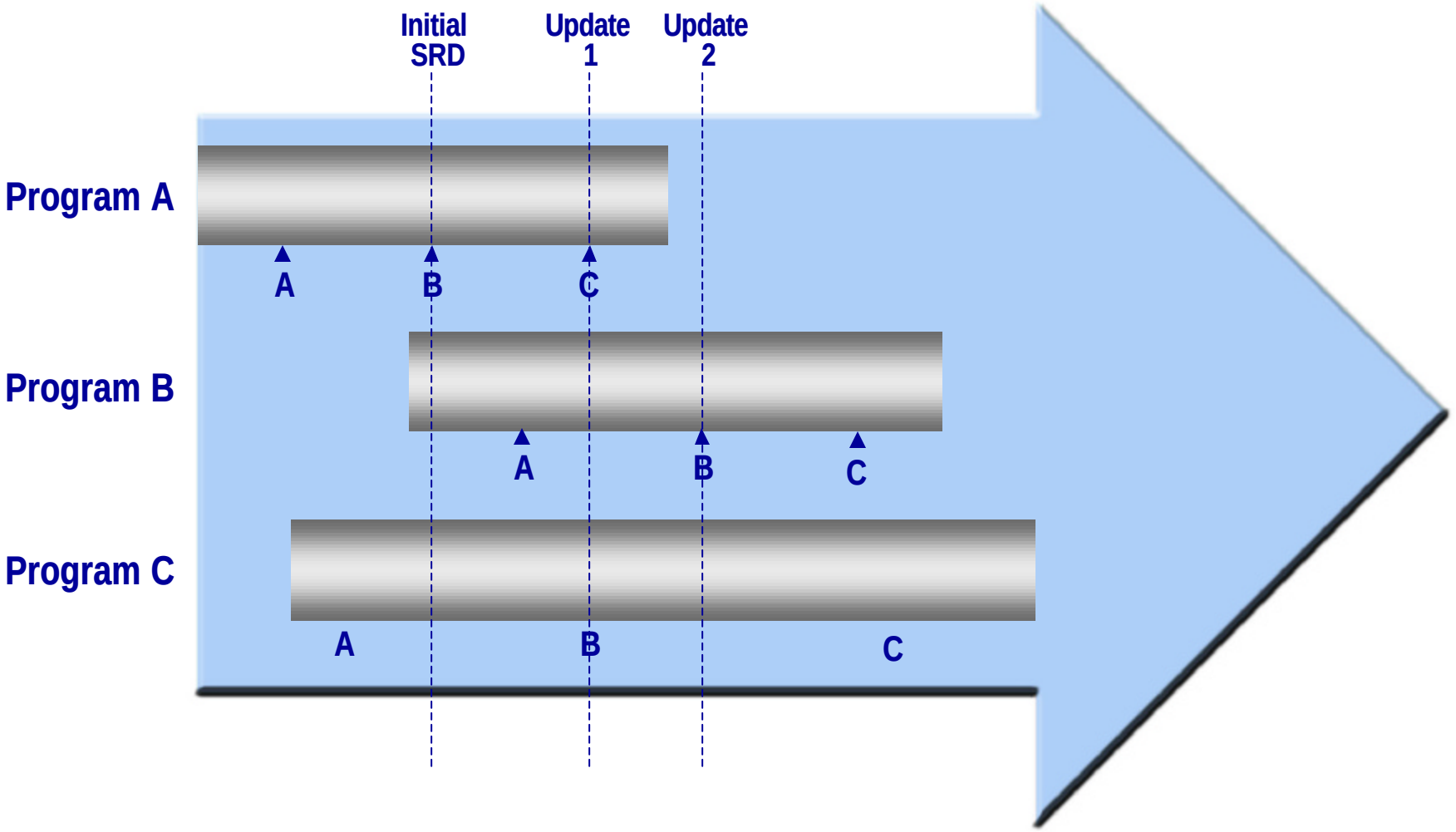

SRD as a Living Document

Requirements Allocation (SoS / FoS)

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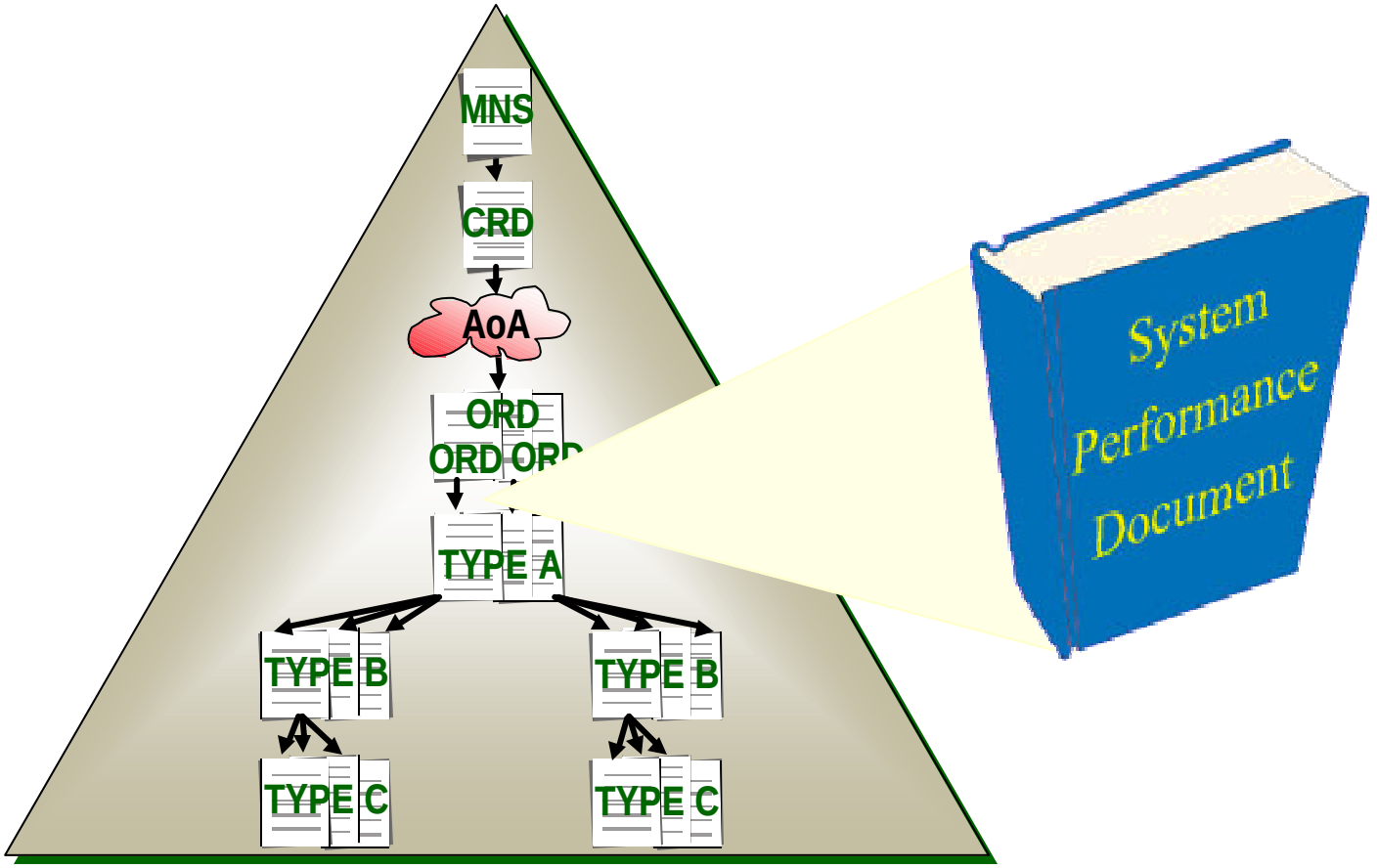

SPD provides a bridge from Operational Requirements to System Requirements

Definitions

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- **System-of-Systems**: *A set or arrangement of systems that are related or connected to provide a given capability. The loss of any part of the system will degrade the performance capabilities of the whole (e.g. National Missile Defense).*

- **Family-of-Systems**: *A set or arrangement of independent systems that can be arranged or interconnected in various ways to provide different capabilities. The mix of systems can be tailored to provide desired capabilities dependent on the situation (e.g. Space Control, Theater Missile Defense, etc).*

SOURCE: CJCSI 3170.01A, 10 AUGUST 1999